

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

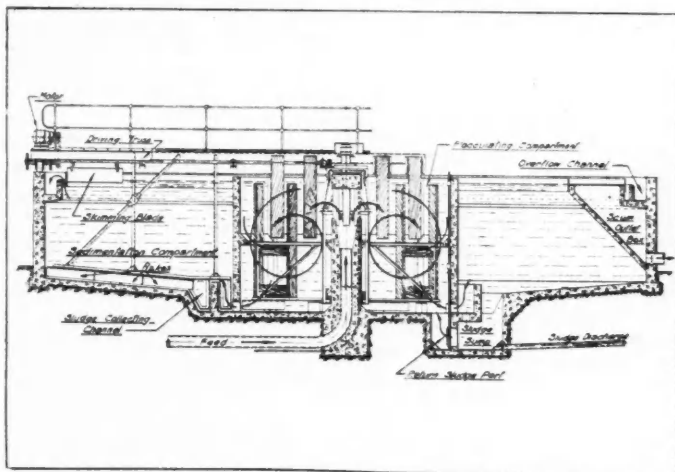
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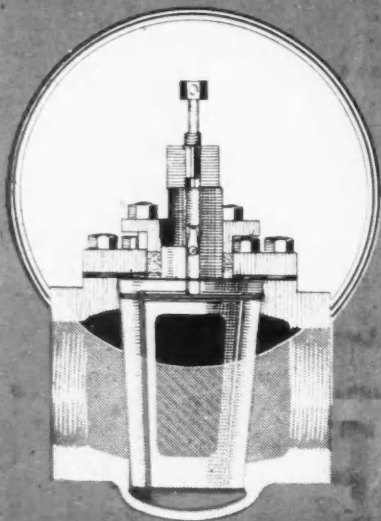


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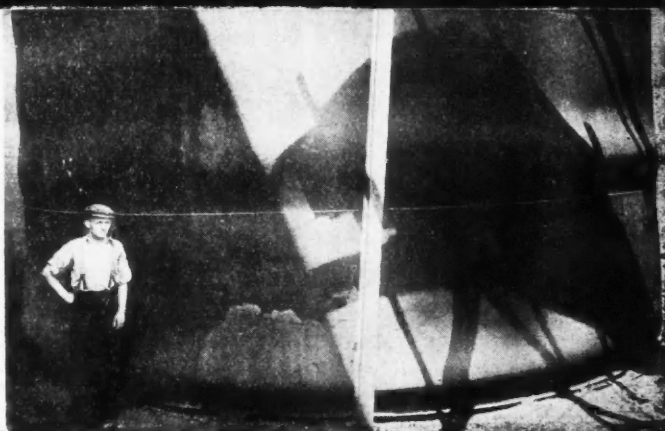
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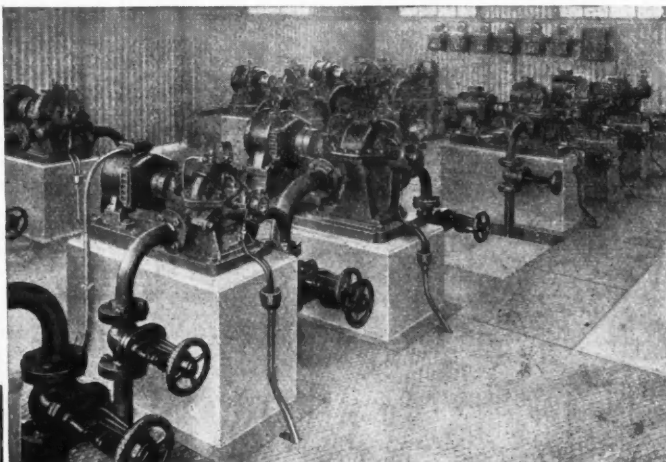
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The Scope of Research

THE uses of research are well recognised by the leaders of most British industries. It is understood by reason of many striking examples from America, Germany and our own country, that the pursuit of pure and applied research, though frequently expensive, leads to dividends in the shape of new industries, greater employment, higher national income, and an improved standard of living. Examples have been given in these pages from time to time of the astronomical sums expended in research by some of the great chemical combines of the world and of the much greater value of the discoveries thereby made. There is growing up a tradition that research pays, and in consequence a good deal of lip service is being given to research even by those who have never conducted research nor supported a research project in their lives.

The ignorance of commercial men concerning technical matters is proverbial and is quite understandable. The almost equally profound ignorance of many technical men as to the potentialities and limitations of chemical research is less understandable and quite indefensible. To place research in any industry on a sound footing it is necessary that the fundamental methods, objectives, and limitations of research should be understood not only by the research men themselves, but by the managerial staffs throughout that industry. Mr. E. V. Evans, Chairman of the Gas Research Board, has done a valuable piece of work in the paper on "The Policy and Scope of the Gas Research Board" which he contributed to the annual meeting of the Institution of Gas Engineers. He has therein pointed out that the word "research" is too frequently used "to impart a spurious air of importance to work of trivial value, or to suggest profound wisdom where but ignorance exists. It is thought by some to be a talisman of miraculous power, and by others to be an excuse for unfettered extravagances." Mr. Evans quite rightly points out that research is fundamentally a way of thought and that in every field of human endeavour, economic as well as technical, where achievement is capable of being measured, the research method can be used with benefit to the speed of progress and the avoidance of wasted effort.

A research association should not in any way reduce the amount of private research conducted by individuals or firms within an industry. The gas industry is not mutually competitive, though contractors to the gas industry must be to some extent competitive with one another. Most other industries are mutually competitive, and thus the research association cannot take the place of private research, but must deal with the many general problems that affect the welfare of all engaged in the industry; the exploitation of the

results of research must clearly be left to the practical, technical, and commercial men. Mr. Evans points out that there is not an unlimited supply of people who possess the combination of ability and experience required for studying the broader problems of any industry, and that therefore the best use of the research ability within an industry can be realised by inviting the co-operation of all units through a central research association. Such an association, moreover, can encourage and guide private investigators who may often, by reason of their limited time or financial resources, be unable to work upon important problems in which they have become interested.

Another important function of a research association is to act as a reservoir of knowledge. It is very often difficult for an individual to discover, in the mass of literature existing throughout the world, the particular piece of work applicable to a problem that he has to solve. A research association, with its special facilities for studying scientific literature, should be in a position to put its hand on anything germane to a particular problem, and may thus obviate the necessity for a great deal of redundant work. Allied to this is another very important function, namely, that of explaining to the practical man the implications of scientific work. Most research work is published in the peculiar jargon of the scientist. This presentation is rather less intelligible to the practical engineer than is the dialect of the engineer to the pure scientist. The research association should act as a link, interpreting the results of pure or applied science to the practical man, as well as indicating the practical opportunities which the research work may have disclosed.

The limitation of research work lies in its practical application. The scientist may be engaged on pure science which at first has apparently no industrial application whatever. He may, on the other hand, be engaged on applied research which has a definite practical objective in view. In Mr. Evans's view, purposive investigation may range from purely laboratory experiments on theoretical issues to the erection and operation of experimental plants, and all stages are properly within the province of industrial research associations. As the new development approaches industrial application, practical questions of cost, life of plant, market for products, etc., arise, and the responsibility for the final stages of commercial development is properly the obligation of industry itself. Research workers and industrialists must therefore co-operate and must learn to speak each other's language. Interpretation in simple terms must thus be a fundamental function of research workers, whether singly or as an association.

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NOTES AND COMMENTS

Hard Times Ahead?

POLITICIANS of the United Nations have vied with each other in recent months in making plans for the post-war world. It is, perhaps, significant that the British Prime Minister is almost the only prominent statesman who has refused to commit himself beyond the primary task of winning the war. That is not, however, quite accurate, for he was a co-signatory with President Roosevelt of the Atlantic Charter, which may reasonably be regarded as the most "official" of the blue-prints so far offered for the future. At any rate, it is significant that in writing of the post-war outlook, Sir Ernest Benn should lay stress on the need for an "Economic Churchill" to inspire the spirit of our people with "toil and sweat and hardship" in the years that will follow the cessation of hostilities. Sir Ernest's latest plea for a return to sound economics is entitled "Hard Times Ahead?" (Individualist Bookshop, 6d.). This is a masterly exposition of the workings of the capitalist system; a brilliant summary of what we owe to the manufacturers and merchants and bankers who were responsible for bringing to the crowded population of the British Isles an unprecedented standard of living, while at the same time spreading the benefits of civilisation over the greater part of the world. Since the theme of the pamphlet is the problem of feeding England without the "invisible" exports which formerly brought us three-fourths of our foodstuffs, it affords a very clear picture of the working of international trade, and particularly of the basic truth that "finance follows work and goods, and is merely incidental to them."

Dependence on Overseas Trade

THE author touches on the Lend-Lease arrangements which will doubtless be carried on for a time. But on a long view there is no reason to suppose that workers in other countries will be prepared to maintain the population of Great Britain "more or less on the dole"; and even if a super-state were established, "it is certain that no World Authority would be justified in allotting to us a higher standard of living than prevailed in those primary producing countries on which we should be dependent." Our dense population was created by the industrial revolution and developed by the system of free exchange known as capitalism, a system which "may be subject to all sorts of criticism," as Sir Ernest admits, "but among all the plans for better ways I know of none which even pretends to be able to support 684 persons on a square mile of soil." England's dependence on overseas trade—"our need to share in the abundance which nature has thought fit to allocate to other lands and different climates"—is much greater than is commonly supposed. Detailed figures of imports and exports for the year 1928, the middle year between the two wars, show that we needed on balance over £14 of food and raw materials per head.

Personal Responsibility Needed

INTERNATIONAL trade before 1939 was steadily declining in volume, at a time when arrangements by Governments, designed to help trade, were steadily increasing. The author quotes figures to show that the fall in British trade since 1919 has been in inverse ratio to the cost of Government expenditure to promote overseas trade. Exports must go to willing buyers in need of them and not to the victims of political restrictions and pressure. What, then, is the remedy? Must we resign ourselves to hard times ahead, and merely hope that some new genius will arise to discover a solution for our economic problems? Is there a more practical alternative? Sir Ernest has no doubt that trade can be re-established by our individual genius and effort, and "there is no shred of evidence that it can be brought back to us by any other means." The world's economic distress is, in Sir Ernest's view, "the natural outcome of the substitution for personal responsibility of impersonal management of everybody's affairs," in other words, of minding other

people's business instead of looking after one's own. The appearance of this sane pamphlet is particularly opportune at a moment when political utterances on the future are being followed up by various bodies representing industry, both in England and America. Two of these, issued by the F.B.I. and by the London Chamber of Commerce, were commented on in *THE CHEMICAL AGE* last week; and all such studies will be read more intelligently with a picture of the pre-war period in mind, for, as Sir Ernest says, "unless we take the trouble to know something of the working arrangements of the past we cannot be qualified to discuss new schemes for the future."

Editorial Board for "Thorpe"

AS was noted in these columns at the time, the publication of Volume V of the new edition of Thorpe's "Dictionary of Applied Chemistry" was announced almost simultaneously with the news of the death of Sir Jocelyn Thorpe, the principal editor. The magnitude of the editorial task in this case being what it is to-day, it was hardly to be expected that the entire burden should have been allowed to rest on the shoulders of Dr. Whiteley, the surviving editor. The publishers, Messrs. Longman, Green & Co., Ltd., have accordingly taken what seems to us a very wise course. They have realised that the distinction made between pure and applied science in Sir Edward Thorpe's preface to the original edition no longer holds good, and that the progress of industrial chemistry is inextricably linked with the advance of pure scientific research. The course they have adopted to meet this situation is to arrange for the appointment of an Editorial Board so as to maintain the balance between the various branches of chemical science. Reference to our "Personal Notes" will reveal that their choice of members for the Board has been wise and comprehensive, and with such a committee of management, the eight further volumes, which it is hoped to publish at yearly intervals, should be models of authority on the subjects that they cover.

Accent on Physical Chemistry

A PARTICULARLY interesting feature is the additional attention which is justifiably paid to physical chemistry, knowledge of which is now a fundamental part of applied chemistry. So far as is possible, physico-chemical articles which would have appeared in Volumes I to V will be included in later volumes under modified titles. It will be remembered that a special index giving cross-references for articles of this kind has already been published; doubtless further such helpful indications will appear from time to time. No major modification of the general character of the Dictionary is contemplated, and it is believed that the addition of the required material on the physical side can be arranged without increase in the number of volumes by the judicious selection of subject-matter and the pruning of historical material. This scheme should make the new volumes of even wider appeal than before and render the work as a whole indispensable to scientific workers in the English-speaking world. It is understood that Vol. VI is now in the Press; its appearance will be awaited with increasing interest.

More Haste Less Speed

SERIOUS injuries resulted from a recent accident involving four persons, one of whom was the plant superintendent. In a sulphuric acid plant, clinker closed the opening of an ore burner. Under the direction of the superintendent the workmen attempted to slice down the clinker through the bottom opening of the ore burner. The clinker and hot ash broke loose and several tons cascaded to the floor, seriously burning the four men. This circumstance, reported in the April issue of *Chemical Safety*, clearly shows the responsibility of the plant superintendent when confronted with an emergency situation. Regardless of the demand for a product, emergency operations must be conducted safely because injuries involving personnel will slow up production and cause a greater loss than will the amount of time that may be consumed in choosing a safer, but slower, method.

SILICATES OF CALCIUM*

Reactions with Water and Relationships with Portland Cement

by THORBERGUR THORVALDSON, University of Saskatchewan

THE field of silicate chemistry is one of very great complexity, and this account will be confined to a comparatively limited and simple part of this subject, namely, the anhydrous silicates of calcium and their reactions with water. Apart from the historical background, it will deal mainly with investigations carried out by graduate students at the University of Saskatchewan during the last twenty years. (It is a pleasure to acknowledge financial aid for this work from the National Research Council of Canada).

Systems containing anhydrous and hydrated silicates of calcium are of special interest in connection with hydraulic cements, refractories, metallurgy, geophysics, and geochemistry.

While the discovery of Portland cement and its early commercial development took place in England, the lead in the scientific study of hydraulic cements soon passed to France and later to America. It is desirable to discuss briefly the work of the man who may be considered to be the first modern scientific investigator of the chemistry of cements, Henri Le Chatelier.

The Work of Le Chatelier

Le Chatelier is generally given credit for being the first to prepare the compounds, dicalcium silicate and tricalcium silicate, and to study their properties. He states that he prepared the former by fusing a 2:1 mixture of lime and silica at a temperature near the melting point of wrought iron. As the melting point of dicalcium silicate is about 600° C. above the melting point of iron, it is likely that the fusion observed was a partial one at the lower eutectic points in the binary system. The conversion to dicalcium silicate must, however, have been fairly complete, as he observed spontaneous "dusting" of the product. He explained this correctly as being due to change in the crystalline form of a dimorphic substance. Le Chatelier found that the fine powder obtained on "dusting" was nearly devoid of hydraulic properties and therefore concluded that the compound "dicalcium silicate can only take a secondary part, if any, in the hardening of cements." He considered this conclusion confirmed by his observation that when "dusting" occurs during the cooling of Portland cement clinker, an inferior cement is produced. It is now known that, in a properly burned and cooled Portland cement clinker of the normal composition, the inversion of the reactive β to the unreactive γ form of dicalcium silicate does not take place and that this compound in the β form is an important hydraulic component of Portland cement. Thus, because Le Chatelier did not succeed in preventing the inversion, he came to an erroneous conclusion.

Le Chatelier was more successful in dealing with the more difficult problem of tricalcium silicate and after a controversy lasting about forty years his conclusions are now generally accepted. While it is very doubtful whether he actually prepared a sample of tricalcium silicate in the laboratory, he discovered that some grains found in hard-burned siliceous hydraulic limes produced on grinding a high-quality cement and that samples of these from a number of different sources gave on analysis a constant molar ratio of lime to silica of 3:1. He therefore concluded correctly that tricalcium silicate is the chief cementing material in Portland cement.

Day, Shepherd, Rankin and Wright of the Geophysical Laboratory in Washington made a thorough study of the system, CaO-SiO_2 , and prepared the following compounds:

1. *Monocalcium Silicate*, or calcium metasilicate (CaSiO_3).

* Address presented to the Quebec City and Montreal Branches of the Canadian Institute of Chemistry, December, 1941. Reprinted from *Canad. Chem. and Proc. Ind.*, 1942, 26, 4, p. 197.

This has a congruent melting point of 1544° C. and exists in two crystalline forms with a transition point at 1150° C. The low-temperature or β form is identical with the natural mineral, wollastonite, the high-temperature or α form is known as pseudo-wollastonite.

2. *Tricalcium Disilicate*, $\text{Ca}_3\text{Si}_2\text{O}_7$ or $3\text{CaO} \cdot 2\text{SiO}_2$.

This substance melts incongruently at 1475° C., giving solid α -dicalcium silicate and melt. Until now it has been considered to be exclusively an artificial mineral, but at the meeting of the Mineralogical Society in London, November 6, 1941, Professor C. E. Tilley reported its occurrence at Scawt Hill, County Antrim, Ireland. The mineral has been given the name "rankinite," in honour of Rankin who first described the artificial preparation.

3. *Dicalcium Silicate*, or calcium orthosilicate, Ca_2SiO_4 or $2\text{CaO} \cdot \text{SiO}_2$.

This has a congruent melting point of 2130° C. and exists in three crystalline modifications, the α , β and γ forms; the α form above 1420° C.; the β form from 1420° to 675° C. and the γ form below 675° C. The transition from the β to the γ form is accompanied by an increase of about 10 per cent. in the volume. This causes the "dusting" observed by Le Chatelier. As the β -dicalcium silicate, either in the form of the solidified melt or hard clinker, cools below 675° C., the expansion shatters the solid progressively into extremely fine dust. Dicalcium silicate occurs in nature as the rare mineral, larnite.

4. *Tricalcium Silicate*, Ca_3SiO_5 or $3\text{CaO} \cdot \text{SiO}_2$.

This substance has no melting point but decomposes at 1900° C. into free solid calcium oxide and solid dicalcium silicate. It is a very peculiar substance. Carlson has lately shown that it also decomposes in the same manner at temperatures between 1050° and 1300° C., giving lime and β -dicalcium silicate. Its stability range is therefore only between the limits 1300° and 1900° C. The difficulty of Le Chatelier and other investigators in preparing this substance by heating mixtures of lime and silica may have been due to not using temperatures within the stability zone.

Calcium Silicates in Cement

Monocalcium silicate and tricalcium disilicate possess no hydraulic properties and are not components of anhydrous cements. Hydrated forms of these may, however, be present in set cement as decomposition products of the silicates higher in lime.

Tricalcium silicate and β -dicalcium silicate are the two most important components of Portland cement. The experimental evidence indicates that tricalcium silicate is responsible for most of the strength developed by Portland cement mortars and concrete during the first seven days, while β -dicalcium silicate is responsible for the increase in strength after this period. The other compounds present in normal Portland cement clinker, the chief of which are tricalcium aluminate, tetracalcium aluminoferrite, and magnesium oxide, act as fluxes during burning and thus lower the temperature necessary for the complete combination of the lime and silica. They may also affect the physical properties of the concrete if exposed to corrosive waters. Gypsum, which is added to the ground clinker, modifies the time of setting.

Tricalcium silicate is not present in high alumina cements such as lumnite, Ciment Fondu, etc. Dicalcium silicate is, however, a component of these cements, but in this case its rôle is less important than that of the aluminates of calcium which are the main cementing substances in this type of cement.

The theory of the setting and hardening of hydraulic cements now generally accepted is essentially a combination of the theories proposed by Le Chatelier in France and Michaelis in Germany. The anhydrous cement com-

pounds are considered to dissolve in, and react with, water to give slightly soluble hydrated products. These products may be formed by direct hydration or through hydrolysis. Solutions which are metastable and supersaturated with respect to the hydration products are formed. When these precipitate out, the solution tends to attain equilibrium with the hydration products, but the anhydrous cement compounds present maintain the solution in the supersaturated state. This process proceeds with some slowing up, due to the time required for diffusion, as long as the liquid phase is present or until the cement compounds are all hydrated.

The essential difference between the views of Le Chatelier and Michaelis was that the former considered that the products of hydration were crystalline, while the latter considered that they were colloidal or gelatinous. The former considered that the intergrowth and adhesion of the crystals formed gave the set and conferred strength on the concrete; while the latter considered that the set was a colloidal phenomenon and that the hardening of the concrete was due to desiccation and shrinkage of the gelatinous mass. The experimental evidence indicates that some of the products of hydration of Portland cement are crystalline and that some are colloidal and that the most plausible view of the processes of setting and hardening combines the two theories.

Hydrosilicates

Although monocalcium silicate and tricalcium disilicate cannot be hydrated at ordinary temperatures, at least two naturally occurring crystalline hydrates of the first and one hydrate of the latter are known. A monohydrate of dicalcium silicate, hillebrandite, also occurs in nature.

The hydration products formed when β -dicalcium silicate and tricalcium silicate are treated with water at room temperature are of special interest to the cement chemist. The formation of gelatinous products, however, makes the study of the process of hydration very difficult. While Le Chatelier did not succeed in hydrating his silicates directly, he made a study of a hydrosilicate precipitated from an alkali silicate by lime-water and came to the conclusion that a monocalcium silicate with $2\frac{1}{2}$ moles of water of hydration is the only hydrated silicate of definite composition which can be formed in the presence of water and an excess of lime.

During the following 40 years many studies of the hydration of the silicates of Portland cement were made. In general it was agreed that calcium hydroxide was liberated, but the composition assigned to the other products by different investigators varied from hydrated forms of dicalcium silicate, tricalcium disilicate, monocalcium silicate to hydrated silica. According to the phase rule, any two of these solid phases, including calcium oxide, in equilibrium with the solution at constant temperature and pressure are sufficient to define the system. Since almost every possible combination, except those including hydrated tricalcium silicate as a solid phase had been proposed, it seemed necessary to attempt to make a further exact quantitative study of the hydration of these silicates.

The first study of the hydrolysis of β -dicalcium silicate and tricalcium silicate was made at the University of Saskatchewan by Dr. Vigfusson. Varying quantities of the pure silicates were shaken with water until equilibrium was attained as shown by a constant concentration of calcium hydroxide. As equilibrium is attained only very slowly, exact results cannot be obtained with glass vessels as containers, and finally gold-lined steel tubes were used in which the solution came in contact only with the noble metal. In order to break up the solid continually and thus to speed up the attainment of equilibrium, some gold shot was placed in the tubes which were constantly rotated in a mechanical shaker. The results indicated that for a given concentration of lime in the solution, the hydration products of both the above silicates had an identical composition; that at high ratios of water to silicate complete hydrolysis to calcium hydroxide and hydrated silica occurs; that a hydrated monocalcium silicate is stable at one stage of the

hydrolysis; that between the limits 1:1 and 3:2 for the lime-silica ratio the solid phase in equilibrium with the lime solution is a solid solution; and that the lime-silica ratio in the solid hydration product approaches 3:2 for saturated solutions of calcium hydroxide.

To answer the question whether these results really represented a true equilibrium between the water and the silicate, Professor Fraser carried out a similar series using lime and silica gel in the ratio 2:1 and 3:1, instead of the corresponding silicates. The curve for the concentration of lime in the solution plotted against the lime-silica ratio of the solid phase was identical with that obtained by Dr. Vigfusson for the silicates. Thus it appears that under the conditions of the experiments, *i.e.*, hydration of the silicates in a large excess of water and with continuous grinding, a real equilibrium is attained.

Dr. Binder studied the hydration of the monocalcium silicate obtained by hydrolysis of the higher silicates. He found that the composition of the product when dried over quicklime at 20° C. was $\text{CaO} \cdot \text{SiO}_2 \cdot \text{H}_2\text{O}$. Bessey, of the British Building Research Station, has since found that when this product is dried at 17° C. at a humidity of 30 to 80 per cent., $2\frac{1}{2}$ moles of water are held, thus agreeing with Le Chatelier's original results. Dr. Binder also found that the presence of sulphates in solution shifted the hydration equilibrium of the silicates, causing greater liberation of lime.

There are several considerations which make the application of these results to the hydration of Portland cement, as it is used in practice, doubtful:

1. The grinding of the solid materials during hydration may carry the hydrolysis further than in set cement, owing to the higher solubility of very small particles.
2. The amount of water used in practice is much smaller so that the major part of the hydration occurs in a saturated solution of lime.
3. It is difficult to obtain equilibrium values in lime water approaching saturation. The presence of any solid calcium hydroxide would make the calculation of composition of the solid phase meaningless.
4. The absence of crystalline solid products makes an exact study difficult.

Steam Treatment

Now another method of attacking this problem may be considered briefly. In studying the great increase in the resistance of Portland cement concrete to sulphate waters, brought about by steam curing under pressure, there was discovered a crystalline calcium hydrosilicate in the form of well-defined rhombic crystals in steam-cured mortars. Mr. G. N. Bates succeeded also in growing these crystals on silica plates immersed in saturated lime water in the autoclave. That gave us a chance to obtain an exact analysis and X-ray pattern of this hydrosilicate. It was found to be a hydrated dicalcium silicate with slightly more than one mole of water hydration. A second quite different crystalline phase of the same composition was also obtained by autoclaving a mixture of lime and silica gel. X-ray patterns showed that both these hydrosilicates differed from the natural hydrosilicate of the same composition, hillebrandite.

Attempts to obtain these crystalline phases by direct hydration of β - and γ -dicalcium silicate were then successful. Dr. N. B. Keovil obtained them both by direct hydration of β -dicalcium silicate in the autoclave and in addition another crystalline phase with a 2:1 lime-silica ratio but with varying amounts of water of hydration according to the conditions of preparation. All these products had characteristic X-ray patterns which showed them to be different from each other and from hillebrandite.

Dr. Keovil's attempts to hydrate tricalcium silicate directly in steam at high pressures were also successful. This was a very striking and unexpected result, as at room temperatures this substance hydrolyses quite rapidly. The hydration product contained up to 2 moles of water of hydration, had a distinctive X-ray pattern which remained constant while the water of hydration varied from 1.3 to 1.9, showing that the second mole of water of hydration does not affect the crystal structure materially. When

hydrated in steam at lower temperatures, one mole of lime was split off from the tricalcium silicate with the production of crystals of the rhombic hydrosilicate of Bates.

On dehydration of the dihydrate of tricalcium silicate at 500°C. only a very small part of the water of hydration is lost and no decomposition of the tricalcium silicate occurs, but at 900°C. the compound is decomposed completely to β -dicalcium silicate and lime. This compares with 1050°C. for the decomposition point for the anhydrous compound as found by Carlson.

The direct hydration of β - and γ -dicalcium silicates and tricalcium silicate to give crystalline hydrates was rather striking and unexpected, as it was generally accepted that hydration of these substances occurred only with hydrolysis. The multiplicity of the crystalline forms of the monohydrate of dicalcium silicate was embarrassing. The formation of two of these crystalline phases by the direct combination of lime and silica in steam, however, showed that we were dealing with equilibrium products.

The fact that crystalline hydrates of dicalcium silicate, which were definitely equilibrium products, were formed at higher temperatures under conditions favouring crystallisation, brought forward the question whether these compounds could not be formed during hydration at room temperature, although conditions were not favourable to crystallisation in well-defined crystalline forms. This led to an investigation of hydration of silicates in the form of pastes.

In this investigation of the hydration of silicate pastes, carried out in the laboratory by Dr. Morrison, Dr. Harvey and Mr. Bryce, electrical conductivity and pH measurements were used to follow the changes in the liquid phase. It was found that the concentration of $\text{Ca}(\text{OH})_2$ in the liquid phase in the β -dicalcium silicate pastes rises close to the saturation point and remains there for a considerable period while hydration takes place, but no appreciable amount of free lime was found to be present at any time up to the point when a microscopic examination indicated complete hydration. This indicates that the product of hydration in the case of β -dicalcium silicate when carried out in a small amount of water is hydrated dicalcium silicate. In tricalcium silicate pastes highly supersaturated solutions are formed and solid free lime is found to be present, but not in excess of one mole of lime per mole of tricalcium silicate, which indicates again that hydrated dicalcium silicate is the end product. Bogue and Lerch have also done work with cement pastes and come to a similar conclusion. Bessey has also found that it is possible to dissolve the crystalline hydrates of dicalcium and tricalcium silicate in lime water near the saturation point without apparent decomposition. It is, however, unlikely that hydrated tricalcium silicate does form to any great extent during hydration at ordinary temperatures.

The experimental evidence thus indicates that the main product of the hydration of both β -dicalcium silicate and tricalcium silicate; i.e., the main cementing material in Portland cement concrete, is hydrated dicalcium silicate.

New Control Orders

Synthetic Rubber

THE Control of Rubber (No. 13) Order provides that a licence is necessary for the acquisition or use of reclaimed or synthetic rubber. Synthetic rubbers are defined as including Buna, Butyl, Thiokol, and Chloroprene, and all synthetic rubbers of the same classes. Another article of this Order brings the use of balata in the manufacture of conveyor and elevator belting under the same control as for rubber.

The Control of Rubber (No. 14) Order, makes numerous additions to the list of articles in the manufacture of which the use of rubber is prohibited or brought under licence. An exception is made of unvulcanised sheeting required by the producer for his own use or for tyre or tube repair material. Copies of the Orders (S.R. & O. 1050 and 1051, 1942) may be obtained from H.M. Stationery Office, or through any bookseller (price 1d. each).

Personal Notes

MAJOR-GENERAL RONALD M. WEEKS, C.B.E., D.S.O., M.C., who has been appointed Deputy Chief of the Imperial General Staff with the rank of Lieutenant-General, is well qualified to deal with the development of military arms and equipment. He is a trained chemist and mining engineer, and in 1939 he became technical and managing director of Pilkington Bros., Ltd., the glass manufacturers.

MR. H. H. HEBBLETHWAITE has been elected hon. treasurer of the Manchester Section of the Oil and Colour Chemists' Association, in place of Mr. F. SOWERBUTTS, who has been transferred by his firm, I.C.I., Ltd., to Birmingham in charge of the dyestuffs group products of the Western Division. Mr. Hebblethwaite will act also as hon. secretary of the section, during the absence of Mr. R. FULTON with H.M. Forces.

At the annual meeting of the Association of British Insecticide Manufacturers, held last week, the following officers for 1942-43 were elected: Chairman, MR. H. J. JONES; vice-chairman, MR. F. H. HALL; hon. treasurer, MR. E. Z. BOLT; hon. auditor, MR. R. A. BLAIR. In view of the continued absence of Mr. J. Davidson Pratt on war service, MR. A. J. HOLDEN and MR. W. A. WILLIAMS were appointed assistant secretaries. The following were elected members of committee: MESSRS. R. A. BLAIR, R. V. CRAVEN, F. H. HALL, J. S. MITCHELL, J. E. R. SIMONS, and DR. E. HOLMES.

It is announced by the publishers of *Thorpe's Dictionary of Applied Chemistry* that the following have been appointed to the editorial board: PROFESSOR I. M. HELLBRON (Professor of Organic Chemistry and Director of the Laboratories for Organic Chemistry at the Imperial College) (chairman), DR. H. J. EMELEUS (Assistant Professor and Reader in Inorganic Chemistry at the Imperial College), PROFESSOR H. W. MELVILLE (Professor of Chemistry in the University of Aberdeen), and PROFESSOR A. R. TODD (Sir Samuel Hall Professor of Chemistry and Director of the Chemical Laboratories in the University of Manchester). DR. M. A. WHITELEY (Assistant Professor of Organic Chemistry at the Imperial College) continues as Editor, and DR. A. J. E. WELCH (Assistant Lecturer in Inorganic Chemistry at the same college) becomes Assistant Editor.

Birthday Honours

Chemical and allied interests figure prominently in the Honours List which was published on Thursday. Knight-hoods have been conferred on MR. ROBERT ALEXANDER WATSON WATT, C.B., F.R.S., President of the Association of Scientific Workers, who has played the leading part in the development of radiolocation; MR. JOHN MCLEAN DUNCANSON, Deputy Iron and Steel Controller, director of the Steel Company of Scotland, Ltd.; MR. HOLBROOK GASKELL, director of I.C.I. and of Magnesium Elektron, Ltd.; and MR. FREDERICK GODBER, managing director of Shell Transport and Trading, a director of many other oil companies, and chairman of the Overseas Supply Committee, Petroleum Board. DR. CHARLES GALTON DARWIN, M.C., F.R.S., Director of the National Physical Laboratory, is made a Knight Commander of the Order of the British Empire, no doubt in recognition of his services in co-ordinating British and American science. The C.B.E. is awarded to MR. F. J. MORTIMER, lately President of the Royal Photographic Society.

Obituary

MR. THOMAS TRUSCOTT MERRIFIELD, consulting chemist, who for four years had been attached to the metallic minerals branch of the Canadian Department of Mines and Resources, died in Ottawa April 24, age 51. Before entering Government service, Mr. Merrifield, who was born at Truro, Cornwall, was employed as chief chemist by the Consolidated Mining and Smelting Co., and later with the Mond Nickel Co. For seven years he was consulting chemist with J. T. Donald and Co., Montreal.

Molybdenum Catalysts

Factors Affecting Activity

CATALYSTS consisting chiefly of MoO_3 or MoS_2 are used in cracking oil. G. Maslyanski and F. Shenderovich (*J. Phys. Chem. Russ.*, 14, 1301) investigated the conditions leading to the preparation of the best catalysts of this type.

The oxide catalyst is prepared from ammonium molybdate which is ignited to give MoO_3 , and the trioxide is reduced to MoO_2 by hydrogen. The activity of the catalyst is judged by the rate of hydrogenation of ethylene or of cracking gasoline. The activity increases with the degree of reduction of MoO_3 , a catalyst containing 99-100 per cent. MoO_2 being twice as active as one consisting of 85 per cent. MoO_3 and 15 per cent. MoO_2 . The catalysts reduced at 300°C . are more active than those reduced at lower (250°) or higher temperatures (350 - 400°C .); it is thought, however, that the reduction at lower temperatures was not complete and the efficiency of a fully reduced catalyst is the higher the lower the temperature at which it has been prepared. The activity is raised by a higher speed of the hydrogen current and reaches a constant level when the speed is very high. This constant activity is not affected by the hydrogen pressure within the range of 50 to 200 atm., but when the hydrogen current is slow the catalysts prepared at 50 atm. are more efficient than those made at 200. It is supposed that the activity of a catalyst is the higher the smaller the amount of water present during its preparation. Since the concentration of water vapour is raised by a rise of temperature, causing an acceleration of the reduction $\text{MoO}_3 + \text{H}_2 = \text{MoO}_2 + \text{H}_2\text{O}$, by an increase in pressure, and by slowing down the hydrogen current, all these variations adversely affect the catalytic activity. If the hydrogen used for reduction is moistened with 2 per cent. of water vapour, a dark brown—as distinct from black—oxide is formed which shows no catalytic activity whatsoever.

The sulphide catalyst MoS_2 is prepared by reduction with hydrogen of the trisulphide MoS_3 . Large variations in the conditions of reduction have only a negligible effect on the activity of this catalyst.

The oxide MoO_2 can be used for pure hydrogenation of double bonds or for destructive hydrogenation (breaking down of hydrocarbons). It is interesting that admixtures influence these functions in dissimilar ways. Potassium oxide and barium oxide lower the catalytic activity generally, but Al_2O_3 and Cr_2O_3 depress the destructive activity and enhance the speed of hydrogenation, whereas clay, ammonium silicate, and ammonium phosphate have little effect on the activity in respect of hydrogenation, and raise the destructive efficiency.

Brazilian Chemical Trade

Blast-Furnace By-Products Budget

THE new Brazilian national steel plant in course of erection at Volta Redonda, with financial and technical assistance from the U.S. Government, the planning of which was recorded in our columns last November, is expected to attain full production by the end of 1943. Meantime, however, in the first year of operation it is expected to produce: pig-iron 260,000 metric tons; steel ingots, 250,000 tons; rails and accessories, 70,000 tons; tinplate, 40,000 tons; thick sheets 25,000 tons; beams and bars, 20,000 tons; thin and black sheets, 15,000 tons; galvanised sheets, 15,000 tons; output increasing in several instances in the second year. Beside these products approximately 40,000 tons of foundry coke will be produced apart from the quantity consumed by the blast furnaces. When in full production the following quantities of by-products are expected to be recovered yearly: tar, 15,200,000 litres; pure benzol, 3,880,000 litres; pure toluol, 896,000 litres; solvent naphtha, 93,000 litres; sulphate of ammonia, 5,200 tons.

During 1941 chemical imports into Brazil included, apart from unspecified quantities of lead arsenate, white zinc sul-

phide, potassium chlorate, potassium chromate, copper sulphate, sodium cyanide, tannic acid, and formic acid, 35,000 metric tons of caustic soda and 21,000 tons of soda ash, valued together at 69,000 contos. Latterly, owing to the expanding needs of the U.S. for these two last products, Brazil has become increasingly dependent upon Great Britain for supplies, and suggestions have been made that a large-scale caustic soda industry should be instituted in Brazil. The work of a British mission to Brazil to study the possibility of erecting a Solvay process plant was noted in THE CHEMICAL AGE in March.

Mineral exports from Brazil in 1941 totalled 1,017,756 tons in volume and 487,803 contos in value, an increase of 90 per cent. and 120 per cent. respectively over the figures for 1940.

Steam Boiler Construction

Improved Type in U.S.A.

THE first "controlled forced circulation" steam boiler to be installed in the U.S.A. is being erected at the Somerset Station of the Montaup Electric Company near Fall River, Massachusetts. This boiler has a continuous steam generating capacity of 650,000 lb. per hour at a pressure of 1825 lb./sq. in. and 515°C . It will supply steam for a 25,000 kW. "topping" turbine, the exhaust from which, after reheating, will be sufficient to generate 47,800 kW. in two previously installed 375 lb./sq. in. condensing turbines. Several years ago Combustion Engineering Company, Inc., acquired the American rights for the manufacture of this type of boiler. While over 700 such units are in operation in Europe, this is the first time that the principle of controlled forced circulation has been used in this country. Great care has been taken to ensure that the unit will meet the requisite standards of efficiency. When Somerset Station was designed and constructed, space was provided for an additional boiler of 200,000 lb. per hour output at 375 lb./sq. in. The new boiler will occupy this space, but will have more than three times the capacity of the boiler originally contemplated. To have installed the conventional type of natural circulation boiler would have required extensive and expensive re-modelling of the building, and the forced circulation design was adopted to keep within the confines of the present building and to ensure proper circulation. The boiler resembles in general arrangement those having natural circulation, except that circulation is effected by means of centrifugal pumps which force the water through the steam generating tubes. These tubes are $1\frac{1}{2}$ inches outside diameter and the ratio of water circulated to steam generated is about 3.85 to 1 as compared with the ratio of 10 to 1 for a natural circulation boiler. Three circulating pumps will be installed, one of which is to be held in reserve, as two will provide full circulation for the boiler at maximum output. Each pump will require 175 h.p. and will have a capacity for circulating about 1,400,000 lb. of water per hour.

SOLVENTS FROM CITRUS PEELINGS

Citrus peelings may become the source of valuable war-industry solvents through a method of extracting these waste products developed and patented by Bruno Rosenfeld of Palestine. Valuable solvents such as ethyl alcohol, butyl alcohol, acetone, and acetic acid can be obtained by fermenting these peelings. Hitherto orange and grape-fruit peelings have been treated to extract pectin and essential oils, the residual pulpy matter, which comprises four-fifths of the peelings, being discarded. It is from this waste portion that the inventor obtains the solvents. The method involves chopping up the peelings and adding water to make a mash, which is inoculated with fermentation-producing bacteria, such as *Clostridium acetobutylicum*. Yields of over 36 per cent. of solvents are said to be obtained. The mash, after fermentation, is washed and dried. The washings are treated with alcohol, thereby precipitating pectic substances, which may be used, in place of starch, as a stiffening agent for textiles.

General News

A specification (D.T.D. 525) for two types of 45-55-ton non-corroding steel in the "En" series (En 56M and En 56A-M) has been published by the Ministry of Aircraft Production. D.T.D. 319 covers aluminium-nickel-silicon brass bars. The price of each is 1s. (1s. 1d., post free).

Preparations for the introduction of fuel rationing at short notice, if that should prove necessary, are considered essential by the Government. Dr. Dalton, who informed the House of Commons of this at question time on Tuesday, also stated that the small staff engaged in this work were about to move to offices previously earmarked by the Ministry of Works and Buildings.

The Minister of Food has amended the Saccharine (Control and Maximum Prices) Order so as to permit the purchase and sale of sweetening tablets containing not less than 0.09 gr. saccharin and 0.06 gr. dulcin. The tablets are subject to a maximum retail price of 9d. per packet of 100 tablets, and a maximum price on other than retail sales of 6s. 9d. per twelve packets, each of 100 tablets.

Pottery and other shaped and fired clay products are no longer subject to a Limitation of Supplies Order, but to an Order controlling manufacture and supply by manufacturers. Unrestricted supply of "synthetic resin cups, beakers, mugs and tumblers in plain ivory colour," by persons registered for Class 14 of the Miscellaneous Order, is permitted as from June 1. The General Licence giving effect to this has been published as S. R. & O. 1942, No. 1062, price 1d.

A revision of the specification for Fabric-Bitumen Emulsion Treatment for Roof Glazing (B.S./A.R.P. 48; price 8d., post free) has been published by the British Standards Institution. Changes in the raw materials have made it necessary to allow an increase in the amount of filler permitted and, as a check against the possibility that this might lead to reduced weather resistance, the period of immersion in the water test has been extended where the filler content of the material exceeds that previously permitted. Further details have been given, as regards the alkalinity test, in cases where ammonia is present. In addition, from experience of the slow deterioration of the fabric, it has been considered desirable to make reproofing compulsory.

The present staff of the Eire Emergency Scientific Research Bureau, according to Mr. de Valera, consists of two part-time engineers; two engineers on loan from other departments; five assistant engineers; two chemists (one on loan from the Industrial Research Council); eight assistant chemists; three physicists; one botanist; one technologist; and five laboratory assistants. When required, special scientific consultants are engaged. Concerning the requirements of fertilisers, the Bureau has concluded that the difficulties involved at present in securing necessary plant make it impossible to manufacture artificial manures on the scale required. Increased production of native phosphate is recommended.

Foreign News

Because of the scarcity of copper, church bells throughout Italy are to be collected and handed over to armament firms, according to a recent statement in the *Popolo d'Italia* of Milan.

Production of pyrites in the United States, in 1941, reached a new record of 659,498 tons, according to the U.S. Bureau of Mines. This represents a 5 per cent. increase over the revised figures for 1940. Pyrites mined in 1941 had an average sulphur content of 42 per cent.

The output of petroleum in Argentina during the first quarter of 1942 was officially recorded at 926,559 cubic metres, compared with 845,479 cu. m. in the corresponding period of 1941. These figures include the production of both state-owned wells (597,563) and privately owned wells (328,996).

Owing to the interruption of supplies of babassu nuts from the Philippines and the intensified demand for glycerine and oil (which these nuts yield), a substantially increased demand is expected from the U.S.A. for Brazilian babassu nuts. In January-February, 1942, exports of this product already showed an increase of 45 per cent. in volume and 177 per cent. in value compared with the like period last year.

From Week to Week

Work is shortly to be resumed on a large scale in a derelict copper mine near Chilecito (La Rioja), Argentina, which was owned by the Banco de la Nación Argentina, but would be leased to the Military Factories Department, according to a statement of the Minister of Marine.

Four men were killed by an explosion at the MacDonald Chemical Works, Waterloo, Quebec, on April 22 last, according to the Department of Munitions and Supply. The explosion occurred in a mixing room and a building was completely destroyed.

A new resin is reported to have been produced by the Hercules Powder Company, Wilmington, Delaware. This product is a modification of abietic acid, in which 40 per cent. of the unsaturated resin acids are polymerised, the remainder being unchanged. It does not crystallise, it has a lower acid value, and, with an m.p. of about 100° C. (20° higher than that of ordinary resin), it can be used to make hard ester gums, modified phenolics, resins, and all the usual rosin products.

Extensive development is reported to be now in hand at the Swedish iron-ore port of Lulea, at the north extremity of the Gulf of Bothnia. New loading quays with cranes are to be built, and deep-water channels are to be dredged in order to admit larger vessels to the port. Hitherto about two-thirds of the ore from the Kiruna iron mines was regularly exported from Narvik; it now appears that the intention is to ship a much larger quantity from the Swedish side. It must be remembered, however, that the Baltic waters are frozen each winter, sometimes as late as April, so that for a great part of the year the Narvik route will still have to be used.

Forthcoming Events

The next meeting of the **Fuel Luncheon Club** will take place at the Connaught Rooms, Great Queen Street, W.C.2, on **June 15**, at 12.40 for 1.10 p.m., when the after-luncheon address will be given by Mr. Emanuel Shinwell, M.P., H.M. Secretary for Mines in 1924 and 1930-31. The cost of the luncheon to non-members will be 7s.; any such visitor wishing to be present is asked to forward his remittance to the secretary at 30 Bramham Gardens, S.W.5.

The **Institute of Chemistry** announces that the second presentation of the lecture on "Recent Advances in Photographic Theory," given by Dr. H. Baines, will take place in the Chemistry Lecture Theatre of the West Ham Municipal College, Remford Road, London, E.15, at 6 p.m., on **June 17**.

Readers are reminded that the first of the series of lectures on "Organic Chemistry," sponsored by the London Section of the **Oil and Colour Chemists' Association**, will take place on **June 18**, at 6.30 p.m., in the Rooms of the Chemical Society, Burlington House, W.1. Dr. H. B. Watson is the lecturer and his subject is "Modern Views on Some Reactions of Organic Compounds." The series continues on June 25 and July 2, and the inclusive fee is 10s. (see *THE CHEMICAL AGE*, May 23, page 263).

There will be a joint meeting of the Bristol and South-Western Counties Sections of the **Chemical Society**, **Institute of Chemistry** and the **Society of Chemical Industry**, at 6.30 p.m., on **June 18**, in the University Chemical Department (Woodland Road), Bristol, when Mr. J. Lumsden will give a paper on "Statistical Methods Applied to Chemical Problems."

The Birmingham and Midlands Section of the **Institute of Chemistry** will meet at the Chamber of Commerce, New Street, Birmingham, at 6 p.m., on **June 24**, when a lecture on "Adhesives" will be delivered by Dr. M. G. M. Pryor.

The annual general meeting of the **Society of Chemical Industry** will be held at the Royal Institution, Albemarle Street, London, W.1, by kind permission of the managers, on **July 10**. The council will meet in the forenoon and thereafter members and their friends will lunch at the Trocadero and Messrs. Stewarts—in two parties. At the termination of the meeting the President and Mrs. Cullen will entertain members and their friends to tea. Further particulars will be announced later.

Company News

Metal Industries, Ltd., report a further dividend of 24 per cent., making 5 per cent. for the year (same).

Goodlass Wall and Lead Industries, Ltd., report profit for 1941 of £305,346 (£266,425), and the dividend is maintained at 6 per cent.

Milton Antiseptic, Ltd., are paying an interim dividend on the ordinary shares, for the year ending September 30 next, payable on June 17.

Canadian Industrial Alcohol Co., Ltd., have declared an interim dividend of 10 cents per share on each of the class "A" and "B" shares outstanding (same).

Cerebos, Ltd., report net profit for 1941 of £238,715 (£244,890), and have declared a final dividend of 30 per cent., making 40 per cent. for the year (same).

The Bradford Dyers' Association, Ltd., have decided to pay the interest on the 4 per cent. debenture stock, as usual, and to defer consideration of payment on account of dividend on the 5 per cent. cumulative preference stock, pending ascertainment of trading results.

British Alkaloids, Ltd. (manufacturers of T.C.P.), have declared final dividends for the year ended March 31, of 8.6 per cent. on the 8 per cent. participating preference shares, making 16.6 per cent. (16.09 per cent.), and of 13 per cent. on the ordinary shares, making 25 per cent. (24 per cent.) for the year.

New Companies Registered

Saez and Co., Ltd. (374,215).—Private company. Capital: £5000 in 5000 shares of £1 each. Importers and exporters of and dealers in chemicals, oils, paints, grease, resin, turpentine, pigments, varnishes, olive oil, essential oils, industrial solvents, laboratory supplies, etc. Subscribers: José Saez; Mrs. Ethel B. Saez. Registered office: 24 St. Mary Axe, E.C.3.

Chemical and Allied Stocks and Shares

ENCOURAGING views as to war developments have continued to govern sentiment in Stock Exchange markets, where in most directions values were again higher on balance. In many instances, however, the rise in prices was out of proportion to the demand experienced, the market having remained poorly supplied with stocks and shares owing to the firmness with which securities are held, and the little selling in evidence. In many cases yields on the basis of last year's dividends are now very moderate; but the disposition is for the strength of the balance-sheet, and views as to the scope for improvement in profits and dividends after the war, to be the main factors influencing share prices.

B. Laporte have participated in the general market trend at the time of writing, and on balance have moved up from 63s. 9d. to 66s. 3d. Business at 18s. 9d. was recorded in British Drug Houses, and at 8s. 10½d. in Lawes Chemicals, while Fison Packard were again 38s. 9d. Morgan Crucible preference shares maintained their recent gains, and changed hands, awaiting publication of the financial results. There was a strong rise from 25s. 9d. to 27s. 9d. in Lever and Unilever, although the market view is that it is quite possible the dividend may again be limited to 5 per cent.; as in many other instances, views as to the scope for post-war recovery are an important influence affecting the trend in the shares. United Molasses at 28s. 6d. lost part of their recent improvement, but the units of the Distillers Co. remained under expectations that the dividend is likely to be kept at 16½ per cent., and rose further, from 75s. 9d. to 76s. 9d. Greiff-Chemicals 5s. units were again quoted at 5s. 7½d., and Monsanto Chemicals 5½ per cent. preference were firmly held and unchanged at 22s. 6d.

Imperial Chemical were active, but on balance have eased slightly to 33s. 4½d., although on the basis of last year's maintained dividend of 8 per cent., the yield now exceeds that obtainable on numerous other leading industrial securities. The prevailing belief is that there are reasonable possibilities that the I.C.I. dividend may be kept at around 8 per cent. during the period of the war. Borax Consolidated were again 31s., and remained firmly held. There was again an upward trend in Boots Drug, awaiting the financial result and the price of these 5s. units has now risen to 37s. 6d. Moreover, in other directions, Barry and Staines have risen further from 30s. 4½d. to 33s. 9d., in advance of the dividend announcement. Nairn and Greenwich held their recent improvement to 52s. 6d., while elsewhere Wall Paper Manufacturers deferred units have advanced further from 25s. to 28s. 9d.—another instance where views as to the post-war position are a stronger market

influence than the immediate dividend yield. British Plaster Board at 22s. 6d. were 6d. higher in response to current estimates of the forthcoming dividend.

Turner and Newall remained in favour, and on balance have risen further from 70s. to 71s. 6d. Goodlass Wall 10s. ordinary responded to the good impression created by the full results, and the price has risen from 8s. 9d. to par. Triplex Glass 10s. units were higher at 32s. 9d., the market having remained hopeful that the dividend for the financial year may be raised to 15 per cent., bearing in mind that in the previous year, when 10 per cent. was paid, profits were struck after a non-recurring loss arising from the sale of a subsidiary. British Glues and Chemicals 4s. units transferred at 6s. 6d., while British Industrial Plastics 2s. shares were 4s. 1½d., Erinoid 8s. 3d., and Lacinoid Products 3s. 3d. Firmness was shown by British Oxygen at 67s. 6d., while Stewarts and Lloyds were 47s. 1½d. and Tube Investments improved to 83s. 6d. Oil shares were better on balance in accordance with the prevailing market trend.

British Chemical Prices

Market Reports

TAKING the general chemical market as a whole, trade during the past week has been fairly active with good quantities called for against existing contracts. Shipments overseas continue on a very restricted scale, but a fair volume of new business on home account has been in circulation. The undertone in all sections is strong, and values have a higher tendency. The majority of the potash products and a number of the soda products continue in short supply, and the supply position generally shows no alteration. Supply difficulties and control restrictions are being felt in the market for coal-tar products, but nevertheless the volume of trade has been satisfactory, the only dull spots being pitch, xylol, and the naphthas.

MANCHESTER.—Generally strong price conditions are the dominant feature of the Manchester chemical market, though there have been no further actual upward movements of any note during the past week. The demand for bleaching, dyeing, and finishing chemicals from the textile trades in the district has been on a fair scale, and, on the whole, there has been little ground for complaint regarding the rate at which supplies are moving to most of the other principal consuming outlets, the soda products generally, as well as the ammonia and magnesia compounds, being taken up in good aggregate quantities.

GLASGOW.—The general position in the Scottish heavy chemical trade remains unchanged. Home business maintains its steady day-to-day transactions while export business is still rather restricted. Prices continue firm.

Price Changes

Chromium Oxide.—Green, 1s. 8d. per lb.

The quantity of pyrites exported from Portugal fell to 37,000 tons in 1941 as against 179,000 in 1940 and 476,000 in 1939. Exports of tungsten increased from 3400 tons to 5200 in 1941. In consequence of an exceptional rise in prices, the value of the tungsten exported in 1941 was 542 million escudos as against 69 million in 1940.

Polymerised vinyl resin is being used in Canada as a substitute for rubber in making raincoats for her service men. The new coats are stated to be better than rubber in many ways. In the first place, they are lighter; suitable waterproofing can be achieved with 3-4 ounces of coating per square yard, whereas more than double that amount of rubber would be needed. Also, they are expected to resist light and heat better, and will not be affected by most alkalis, acids, alcohols, petroleum solvents, oils and greases.

No less than 1700 soap-saving washing powders are said to be on the German market, a variety mainly due to regional differences in the supply of raw materials. The most common types of solid washing products for industrial use contain from 80 to 95 per cent. of powdered pumice-stone, kaolin and other abrasive fillers. Usually up to 3 per cent. of fats is included, mostly obtained by new processes from naphthalene or paraffin. Either chestnut flour or "Saponin," which is described as a similar substance though obtained from an imported raw material, is usually added to the washing agents to form a lather. Other ingredients are soda and silicate.

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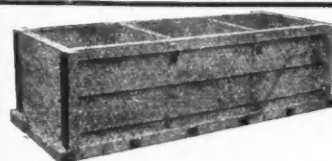
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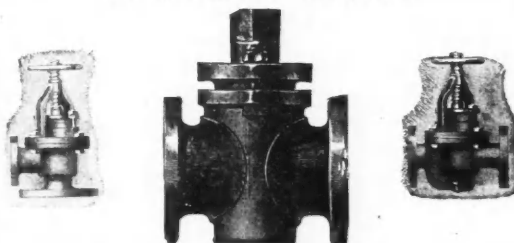
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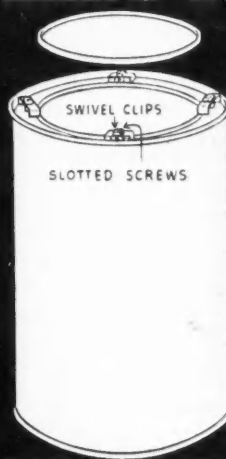
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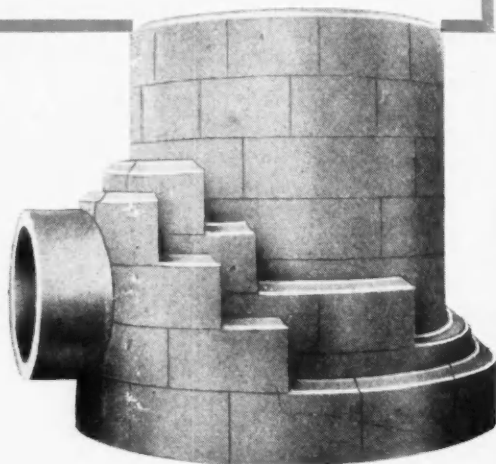
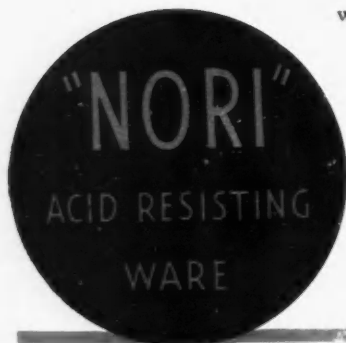
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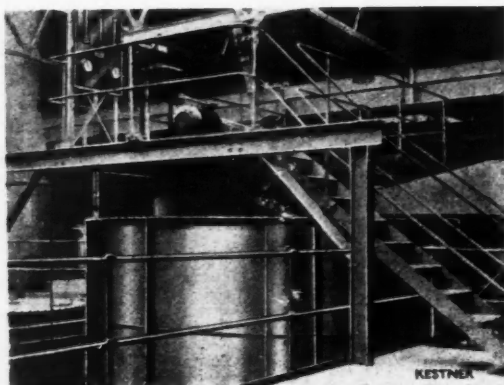
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